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ABSTRACT

A study examined the learning stages involved in training students classified as poor readers to use networking, a notetaking technique, as a strategy for studying text material. Subjects were two male students enrolled in an auto mechanics vocational education program at a two-year college. Test scores indicated their reading levels to be 8.0 and 8.3. Researchers chose eight reading selections from an auto mechanics text with a readability level of 7.9, prepared a cognitive map for each selection, and constructed five comprehension questions using the maps. They also prepared a prose analysis of each selection using a system of stages to organize the content into a hierarchical propositional representation of the ideas and relationships among ideas in the passage (Meyer, 1975). Students were trained in the use of networking twice a week for 5 weeks, with each session lasting 1 hour. Results showed that, contrary to other research findings, the students did not improve their recall performance after the short training period in the networking strategy. The students were beginning to apply the strategy; however, much more time would have been required for them to master it well enough to transfer it. The study was terminated because the students indicated that they were bored and wanted to stop. (FL)

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EFFECTS OF TRAINING JUNIOR COLLEGE STUDENTS TO USE NETWORKING TECHNIQUES TO UNDERSTAND AND STUDY TECHNICAL TEXTS

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EFFECTS OF TRAINING JUNIOR COLLEGE STUDENTS TO USE NETWORKING TECHNIQUES TO UNDERSTAND AND STUDY TECHNICAL TEXTS

Recently several American researchers have used Vygotsky's concept of the zone of proximal development to study and explain learning differences among students (Vygotsky, 1978; Brown, 1981). A goal of this research has been to test Vygotsky's theory of cognitive development; another goal has been to determine the amount and kind of instructional intervention needed to help poor readers and slow learners acquire new skills and capacities.

Vygotsky, a Soviet psychologist, was one of the first experimental psychologists to examine the effects of instruction on cognitive development. To do this he employed a microgenetic research approach (Wertsch, 1979). Microgenetic research involves studying how individuals gradually acquire psychological processes or skills over relatively short periods of time. Vygotsky used this research strategy so that he could 1) qualitatively describe stages that occurred in learning, and 2) identify factors that affected transitions between stages as learners progressed from novices to experts in using cognitive skills (Brown & Ferrera, 1979; Brown, 1980). Instead of simply describing skilled behavior, Vygotsky's goal was to explain how cognitive ability or expertise develops.

Using a microgenetic research strategy, Vygotsky (1978) found that individuals with similar scores on standardized tests differed in their capacity to profit from instruction. Students varied in the amount of time and instructional support they needed to learn new skills. To identify such differences, Vygotsky proposed that psychologists and teachers needed to establish two performance levels: a level at which students can perform independently with success (an index of past learning) and a level at which

students can succeed only when given guidance and instruction (an index of potential for learning). The difference between students' performance on these two measures Vygotsky (1978) called the zone of proximal development. This zone reflects regions within a student that are sensitive to instruction, i.e., levels at which a student is ready to learn. Vygotsky claimed that the zone measure provides diagnostic information as to the amount of instructional support individual students require as well as an estimate of how far or rapidly different students can progress in educational settings. Students with wide zones require less instructional support and time to acquire new skills; whereas, students with narrow zones require more help and time to acquire new skills.

The purpose of this paper is to present the results of an exploratory study designed to qualitatively describe the learning stages involved in training two students classified as poor readers to use networking as a strategy for studying written material (Dansereau, 1979). Before describing the study, we briefly review a series of studies by Day (1980), designed to test Vygotsky's concept of the zone of proximal development. Results of her research, as well as results of studies related to training students in notetaking strategies, provide the rationale for the present study. We employed a single-subject research design with repeated measures (Kratochwill, 1978), for our study because, in addition to being a microgenetic analysis, the goal of our study was to chart the development, as it was displayed over time, of a notetaking/study strategy being learned by two students. This paper presents the reasons for using this type of research strategy, a description of the procedures used, results of the study, and a general discussion of 1) the difficulties encountered in using a single-subject research approach, and 2)

the potential fruitfulness of the approach for reading researchers interested in studying how individuals differ in their ability to acquire strategies for learning from text.

ZONE DIFFERENCES IN THE ACQUISITION OF SUMMARY-WRITING SKILLS

Day (1980) conducted a series of studies to examine Vygotsky's concept of the zone of proximal development. Her goal was to determine if students with similar pretest scores on tests of summary writing differed in the amount and type of instruction needed to acquire skill in writing summaries. Day predicted that explicitness of instruction could be used to determine student ability (zone) levels as well as specify the kinds of instructional support required by different students to help them develop summary writing skills.

In one study, Day examined the effects of varying the explicitness of training for students with and without diagnosed writing problems. The other study involved intensive, one-to-one training for students with diagnosed reading and writing problems. Subjects in both studies had similar scores on summary-writing pretests. All subjects in the first study, whether good or poor writers, improved their ability to write summaries following training. The performance of good writers improved regardless of the type of training they received. The degree of improvement observed among students classified as poor writers, however, varied depending upon the type of training they received. Poor writers who received explicit rule training plus instruction in techniques to monitor their application of the rules improved significantly more than poor writers who received less explicit instruction.

Results of the second study indicated that students with reading and writing problems required more extensive training to learn the summarization

rules than students with writing problems only. Moreover, students in the second study were unable to master the most difficult summarization rules by the time training was suspended.

Day (1980) interpreted these results as support for Vygotsky's concept of the zone of proximal development. Pretests or initial performance scores predicted neither the type of students who would benefit from instruction nor the amount of instruction required by different students to develop summary writing skill. What did differentiate among groups of students was the explicitness of training needed to produce learning. Good writers required less explicit instruction than poor writers, and poor writers required less extensive instruction than students diagnosed as poor readers and writers. Thus, Day concluded that 1) the degree of instructional support required to improve summary writing performance differentiated among students of various ability levels better than initial pretest scores, and 2) students with narrow zones of proximal development required more explicit and extensive instruction to develop skills for writing summaries than students with wider zones of proximal development.

Day did not examine if learning how to write summaries improved students' ability to learn from text, since that was not the purpose of her study. Other researchers, however, suggest that training students to write summaries or use other notetaking procedures improves their ability to understand and study written material. The next section will briefly review research related to training students in various prose learning strategies, focusing particularly on studies designed to examine the effects of training students in the use of networking as a notetaking strategy for learning from text.

RESEARCH ON NOTETAKING STUDY STRATEGIES

Summary writing, notetaking, and underlining are types of learning activities frequently taught in study improvement courses. While many educators feel these are useful activities, little empirical evidence exists to support teaching students to use these common study aids (Anderson, 1980; Faw & Waller, 1976). Two types of research have been conducted to examine the effects of student generated study aids on learning. Most researchers have compared the learning performance of groups of students directed to use different types of study activities such as rereading, outlining, or summarizing. The goal of this research is to determine if one type of study activity is superior to another. Subjects are directed to use a particular type of study strategy, but they are not provided training in how to use the strategy. Other researchers have investigated the effects of training students to use specific kinds of study aids. In these studies, researchers compared the recall performance of subjects trained to use a particular study aid, such as outlining, to that of subjects who did not receive such training.

Reviewers find that results of both types of studies often conflict and, therefore, are inconclusive (Faw & Waller, 1976). They suggest that results may conflict because 1) study times were not consistently controlled or accounted for in numerous studies, and 2) the effects of notetaking may interact with individual differences among subjects. In most studies researchers failed to consider the entry-level performance of subjects who participated in the studies; thus subjects may have differed in their ability to use specific types of study aids or in their readiness to benefit from instruction in how to use particular notetaking strategies.

DIAGRAMMING PROCEDURES

Despite the meager research support for training students in various kinds of notetaking strategies, psychologists now advocate that students learn how to take notes, as they study, by creating diagrams of information they read (Dansereau, 1978; Dansereau et al., 1979a, 1979b; Armbruster & Anderson, 1982). Two types of diagramming procedures have been developed. Dansereau (1978) has developed a procedure he calls "networking," and Armbruster and Anderson (1980) have created a system they call "mapping." Essentially, both procedures are notetaking techniques. Students are trained first to identify the organizational structure of passages and then to use that organization as a basis for taking notes in a two-dimensional format. These notes should reflect clusters of ideas, the relative importance of the ideas, and the specific logical and temporal relationships that tie the ideas together.

Mapping and networking diagrams are considered superior to other study techniques because the diagrams supposedly reflect the way information is organized in memory. Clusters of ideas in the notes are compared to concept nodes in memory. Relations among clusters are compared to the links which tie concept nodes together into hierarchical network structures in memory.

Several studies have been conducted to determine if students trained in these procedures remember more information from texts than subjects who use other study strategies. Results of all these studies indicate that students who use a diagramming technique recall more information than untrained subjects or subjects trained in other study strategies, such as elaborative/mnemonic strategies (Danereau, 1978; Dansereau et al., 1979a, 1979b; Holly et al., 1979; Armbruster & Anderson, 1980). Closer inspection of the results

of these studies, however, indicates that the facilitative effects of networking and mapping are no more straight-forward than the facilitative effects of other notetaking procedures.

For instance, Armbruster and Anderson (1980) found that the recall performance of eighth-grade students trained in mapping procedures actually decreased when posttests were administered after training. Although trained subjects' recall exceeded that of untrained subjects, the facilitative effect observed in this study is most likely attributable to increased time on task rather than use of the diagramming procedure per se. Moreover, Holly et al. (1979) obtained an aptitude-by-treatment interaction effect in a study they designed to examine the effects of training college students in networking, the diagramming procedure developed by Dansereau (1978). Subjects in this study were assigned to treatment groups based on their over-all grade-point-averages (GPA). Half of the students were trained in the networking strategy, and their recall performance following training was compared to that of subjects asked to use their typical strategy for studying texts. Results indicated that after training students trained in the networking procedure achieved higher scores on recall and recognition tests. Post hoc analyses, however, indicated that most of this effect was attributable to the performance of students with low GPA's. These students recalled significantly more ideas related to main ideas than students with low GPA's who used their own study techniques. Students with high GPA's who were taught how to use networking, however, recalled fewer main ideas than untrained subjects with high GPA's. Thus, Holly et al. (1979) concluded that training in networking may be more useful to students of low ability who lack effective strategies for studying prose, than it is for high ability students who already have developed effective strategies for learning.

Results of these studies, like the results of other studies on notetaking, are again inconclusive. Apparently, diagramming ideas from texts helps certain students some of the time, but as with other procedures, the effects vary with the age and ability level of the students. No research, moreover, was located in which the effects of training students in networking or mapping were compared to the effects of training students in more traditional notetaking strategies. Nevertheless, psychologists and reading educators are now exhorting teachers to train students to use networking or mapping as a way to improve their understanding of and memory for text (Armbruster & Anderson, 1982).

PURPOSE OF THE STUDY

Despite the popularity of these procedures, the authors of this study suspected that students, especially underachieving students, would experience great difficulties in learning how to use either strategy. Mapping and networking are notetaking procedures which involve identifying and using organizational patterns in texts. Such skills are the basis for training students to create diagrams of ideas from texts, yet most underachieving students are unable to identify and use organizational patterns as a basis for studying information they read (cf Meyer et al., 1979). In addition to these types of prerequisite abilities, students must also possess some skill in abstracting and summarizing ideas they read. Without such skill, any notetaking procedure becomes too cumbersome and reduces to an exercise in copying information from text in a verbatim fashion. As noted by Day (1980), underachieving students might lack such skills, and it takes much more time and explicit instruction to help students develop them. Thus, it appeared to us that 1) many underachieving students might lack prerequisite skills to

profit from instruction in diagramming procedures, and 2) reading achievement scores or preliminary tests of notetaking skill could not be used to predict the amount of time or instructional support unsuccessful students would need to develop skill in using a diagramming procedure as a strategy for learning from text.

For these reasons, we felt researchers' recommendations that students be taught mapping or networking strategies were much too sanguine, particularly in the case of underachieving students. We decided, therefore, to conduct an exploratory study to identify for ourselves factors that influenced unsuccessful students' ability to learn a diagramming study procedure. To do this, we observed the development of a networking strategy, as it occurred over time, in two students. The students were attending a junior college, and they were classified as academically disadvantaged based on their scores on a standardized reading test. We focused on training the students to use networking, the procedure developed by Dansereau (1978), because it is less complex than mapping; fewer symbols are used and the format of the diagram is more straightforward.

METHODOLOGY

Subjects.

The subjects for the study were two male students enrolled in the Auto Mechanics Vocational Education program at a Junior College in the southern part of Mississippi. They were selected on the basis of their reading scores from a group of students who had volunteered to participate in the study. They had reading scores of 8.0 and 8.3 on the Test of Adult Basic Education (TABE), which indicated that they were reading at approximately the same level

when selected for the study.

Procedure.

Prior to the study, the investigators had selected reading/instructional material from an auto mechanics book which had a calculated readability level of 7.9. Eight selections, each approximately 800-1,000 words were typed. For each selection, the investigators prepared a cognitive map and constructed five comprehension questions using the maps to construct the questions. The investigators also prepared a prose analysis of each selection using Meyer's (1975) representation system. Meyer's system is a method for organizing the content of a passage into a hierarchical propositional representation of the ideas and relationships among ideas in the passage. In format, prose analysis is similar to a cognitive map or network diagram.

In addition to controlling entry level of the subjects and the type of materials used, the investigators controlled the teaching procedures by carefully outlining the teaching steps that would occur each session. However, the investigators did not control the amount of study time nor the amount of instruction per session. The investigators planned to devote eight-to-ten hours to training activities and the collection of data, since Dansereau et al., (1979) had stated that networking skills could be taught in five-to-six hours.

The investigators began the study in September, 1982, meeting with the students twice a week for five weeks; each session lasted one hour. Each day's session is described below.

Day 1: a) The investigators established rapport with students.

b) Students were told to read and study Passage 1 until they could tell the investigators the content of the passage.

c) Students read Passage 1. (While they were reading and studying

the passage, the investigators made notes of their study behaviors. It was observed that neither student made study notes of the material. The reading/study time devoted to the passage was 31 minutes for Student X and 27 minutes for Student Y.)

d) Students were told to recall as much of the content of Passage 1 as they could remember. (The investigators recorded all of their free recall ideas.)

e) The investigators read each of the five comprehension questions, which had been constructed earlier, and recorded the students' answers to the questions (probed recall).

Day 2: a) Students were told to read and study Passage 2 until they could tell the investigators the content of the passage. (The investigators suggested to the students that they take notes on the material.)

b) Students read Passage 2. (Student X asked if he could just underline the major points in the passage rather than take notes. Student Y took notes but did not organize them by idea or topic. The total time devoted to reading/studying the passage was 52 minutes for Student X and 29 minutes for Student Y.)

c) Investigators recorded their free recall ideas.

d) Students responded to probed recall and their answers were recorded.

Day 3: a) Students were told to read and study Passage 3 until they were ready to tell the investigators the content of the passage; note-taking was optional. (Neither student chose to take notes over the material. Student X spent 20 minutes and Student Y spent 40 minutes reading/studying the material.)

b) Investigators recorded their free recall ideas.

c) Students responded to probed recall and their answers were recorded.

Day 4: a) Students responded to an activity designed to identify whether or not they were spontaneous categorizers of information. (If they were unable to categorize information spontaneously, the investigators planned to teach them categorization skills. Both were spontaneous categorizers of information to a limited degree and were given ideas by the investigators about how to improve their categorization skills.)

b) Investigators demonstrated categorization strategies which aid the retention of information.

Day 5: a) Students described the thoughts and feelings they had experienced during the spontaneous categorization activity on the previous day.

b) Investigators explained the relationship of categorization skills to networking skills.

c) Investigators started instruction in networking by using the phrases main idea(s), details, descriptive information, etc.

Day 6: a) Investigators continued networking instruction by introducing ideas from three structural levels (i.e., hierarchy, chain, cluster structures), such as Part of, Type of/Example of, Leads to, Is like (analogy), Characteristic of, and Evidence of; key words/phrases from the three structural levels, such as is a part of, are, causes, is like, is similar to, has, indicates, is proof of; and, placement of ideas into a network diagram.

b) Using a short passage of approximately 150 words, students verbally responded to questions, asked by the investigators, about the passage, such as:

1) What are the types of systems that make-up an engine?

2) What is a characteristic of the ignition system?

3) Which system causes the mixture of gas and air to be compressed?

4) Oil is a part of which system?

Day 7: a) Investigators reviewed the networking skills taught on Day 6 and assisted the students while they practiced placing ideas from a short passage into a network diagram.

b) Students were told to read and study Passage 4 until they were ready to tell the investigators the content of the passage, to prepare a network diagram of the material, and to study the diagram.

Day 8: a) Students continued working with Passage 4, reading, studying, and diagramming the content. (Student X spent 75 minutes and Student Y 39 minutes working with Passage 4.)

b) Investigators recorded their free recall ideas.

c) Students responded to probed recall and their answers were recorded.

Day 9: a) Students were given Passage 5 to read, study, and diagram.

b) Students started preparing network diagrams of Passage 5.

Day 10: a) Students completed their diagrams of Passage 5 and studied them in preparation for recall of the content. (Student X devoted 74 minutes and Student Y devoted 36 minutes to working with Passage 5.)

b) Investigators recorded students' free recall ideas.

c) Students responded to probed recall and their answers were recorded.

All instruction was individualized, and each student worked with the same investigator throughout the study. Student Y worked more slowly than Student X on Days 4, 5, 6, and 7, extending his instruction on basic networking skill into Day 8; therefore, he had less time to devote to Passages 4 and 5. All ten sessions were videotaped so that the investigators could study the interaction between themselves and the students. The investigators terminated the study after ten hours because 1) the students were becoming bored with the procedure; and, 2) it was evident that many more hours would be required in order for the students to acquire the skills.

Data Analysis.

For each passage the students' network diagrams were compared to the diagrams prepared prior to the study by the investigators. Equal weight was given to the three levels (i.e., Levels 1, 2, and 3) of information. The percentage of information contained on students' diagrams at each of the three levels, was calculated. The students' free-recall ideas for each passage were compared to the prose analysis of that passage, and points were given for verbatim content only; points were not given for meaning relationships because of fear of score inflation. The percentage of information recalled for each passage was calculated. The students' probed-recall responses were scored by assigning a 0 to item responses which were not discrepant from the correct answers, a +1 to item responses which were partially correct or which contained an overly generalized response, and a -1 to item responses which were totally discrepant from the correct answer. The results of the analyses were used to prepare a variety of graphs.

RESULTS

Using basic ideas of time-series research (Kratochwill, 1978), several graphs were debised to examine 1) which factors influenced the two under-achieving junior-college students' acquisition of networking, and 2) how learning occurs within individuals when given instructional support. Figures 1.1 and 1.2 illustrate the relationship between performance on each of the five passages and the factors of minutes of study time, percent of free recall ideas, percent of free recall ideas contained in students' notes, and percent of students' notes which matched with teachers' notes for students X and Y, respectively.

Insert Figures 1.1 and 1.2 About Here

As shown in Figure 1.1, Student X showed an increase in performance on the four factors after instruction in networking. However, Student X did decrease slightly the minutes of study time for Passage 5, but this did not effect his recall of ideas from the passage. As shown in Figure 1.2, Student Y showed more variation in performance on the four factors after instruction in networking. Student Y varied little in minutes of study time for passages 3, 4, and 5, decreased in performance between passages 3 and 4 except for the percent of free recall ideas contained in his notes, and then immediately increased the percent of free recall ideas and the percent of ideas in his notes which matched with the teacher's notes for Passage 5 but decreased in percent of ideas in notes and free recall. A possible explanation for the downward performance on Passage 4 is that networking instruction had occurred and possibly Student Y was concentrating more on acquiring the mechanics of

the process, which could interfere with recall of ideas. Figures 1.1 and 1.2 seem to indicate that the factors of study-time, notetaking based on free recall, and notetaking based on the networking model do influence the acquisition of networking but extent of the influence appears to be a within-learner variable. This finding is consistent with Vygotsky's (1978) suggestion that instructional differences among students only emerge as they are provided training in specific skills.

Figure 1.3 illustrates the percent of ideas recalled by level within the content structure for Students X and Y on each of the five passages. Level 1 information related to the main ideas of the passages; Level 2 information pertained to the detail ideas which supported the main ideas; and, Level 3 contained embedded information in support of main ideas or details.

Insert Figure 1.3 About Here

As shown in Figure 1.3, prior to networking instruction both students were recalling a higher percentage of main ideas than details. After instruction in networking, Student X decreased in the percent of Level 1 ideas recalled, remained constant in percent of Level 2 ideas recalled and increased in the percent of Level 3 ideas recalled. Student X had a better balance in his recall of ideas for Passage 5 (i.e., L1 - 45%, L2 = 51%, L3 = 68%) than for Passage 4 (i.e., L1 = 78%, L2 = 51%, L3 = 69%). It may be that as students begin to concentrate on the more difficult-to-remember ideas in a passage, they place less concentration on the main ideas in a passage; if this is the case, they should eventually be able to recall ideas equally well at all three levels.

After instruction in networking, Student Y remained constant in percent of Level 1 ideas recalled, increased in the percent of Level 2 ideas recalled, and increased in the percent of Level 3 ideas recalled. Student Y was recalling mostly Level 1 ideas prior to instruction. His performance lends further support to the idea that as students become involved in the acquisition of networking skills, they may place less concentration on main ideas and more concentration on details and support information contained in passages. It is important to note that ideas in auto mechanics texts, which represent the third level of information, are those which distinguish the differences in types of engines, functions of mechanical parts, etc. Hopefully, once a student is able to recall Level 3 information with ease, his concentration while studying can then be distributed among the three levels, so that he focuses on the important distinctions among facts presented in a text. Having acquired the ability to know where to focus their concentration, students will have mastered the networking strategy.

DISCUSSION

While other investigators have been able to show improvement in students' recall performance following relatively short periods of instruction in diagramming procedures, we were unable to do so. The students in our study were beginning to apply the strategy as demonstrated by their recall performance on the last two passages. But much more time would have been required for the students to master the strategy well enough to transfer and use it to study on their own. Essentially we terminated the study because the students were bored, and they wanted to stop. Similar problems were encountered in the study conducted by Armbruster and Anderson (1980). In that study, students complained about having to use a diagramming procedure because it was

too boring and time-consuming. Nevertheless, this is also a problem inherent in any study in which a single-subject research design is employed. Before discussing the problems and potentials of using single-subject designs in educational research, a brief discussion of some of the findings from the study is presented.

The students who participated in our study lacked many of the skills and insights needed to learn the networking procedure, either as a strategy for taking notes or as a technique for studying for tests. When first asked to study a passage for recall purposes, the students simply reread the text. Even when the students were required to take notes as they read, they did not see the usefulness of the notes as an aid during study of content. They ignored the notes and, again, simply reread the text to help them remember information for the recall tests.

Examination of the notes produced by the students before training was initiated revealed some basic differences between the students' skill in notetaking. Student X summarized ideas from the text and used indentation to differentiate between main ideas and details. Student Y, on the other hand, copied verbatim from the text, and his notes showed no differentiation between important and less-important information. These differences did not emerge until repeated pretests were administered, and the differences became more distinct after instruction began. Student X made more rapid progress and needed less instructional support to learn the networking procedure than Student Y. These differences could not have been predicted from the students' performance on a standardized reading test, a single pretest on notetaking, or the students' prior knowledge of the content they were asked to study. The students' performance on all of these initial measures indicated that

they were performing at approximately the same achievement or ability levels. Since ability differences did emerge during the instructional phase of the study, it appears that the students had differing levels of ability that were not revealed by traditional test measures. We interpreted these findings as showing that 1) the students had different zone levels (i.e., they differed in their readiness to profit from instruction); and, 2) Student X had a wider zone of instructional readiness than Student Y.

Single-subject research and case-study research are not without problems. Obviously, the results of such studies cannot be generalized and, as in our study, instruction may have to be terminated because individuals no longer wish to participate in a study. Generalization can be improved, however, by designing studies in which replication is built into the overall design of the studies (cf Kratochwill, 1978; Elashoff & Thoresen, 1978). Moreover, should students wish to withdraw from a study, useful information can still be obtained. In the present study, for instance, the students found the procedure boring. Similar student reactions were reported by Armbruster and Anderson (1980). Such findings indicate that some students will not learn or employ a diagramming strategy because of attitudinal factors, and this suggests either that 1) this type of training should not be initiated with certain students; or, 2) researchers and/or instructors need to devise ways to make learning and using a diagramming strategy more palatable for students.

Although other researchers have shown that groups of students can be taught networking within a five-to-six day period, it appears that the results of these studies obscure the amount of time and instructional support individual students need to master the skill. Students enter instructional settings with a wide-range of abilities that may or may not enable them to profit from

instructional interventions. Such instructional differences may not be predictable from traditional test measures and may only appear during the process of teaching students how to employ a learning skill. Thus, there is a need in educational research for more case studies and single-subject research, especially when the purpose of the research is to show the effects of instructional interventions on student learning behavior. When that is the goal of a research study, then responses to all phases of instruction are the most significant aspect of the study. These responses are lost when the average performance of groups of subjects following training is the primary data provided in research reports.

There is a need for qualitative descriptions in the research literature of how various instructional treatments affect the performance of individual students before, during, and after training is provided. The results of this type of research can then be used as a basis for generating hypotheses and designing group research studies.

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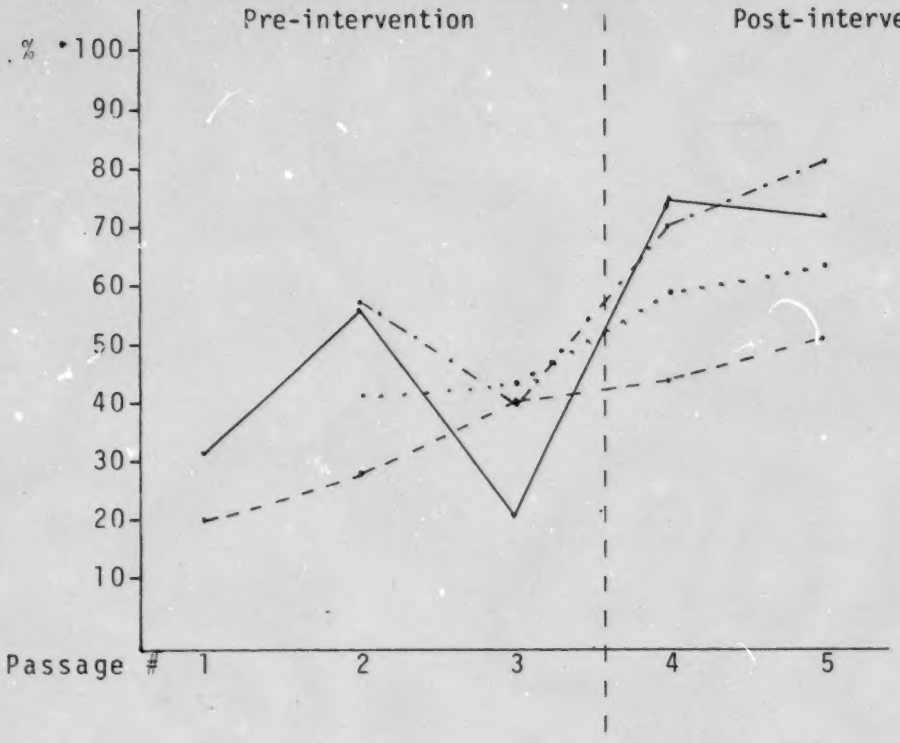

Figure 1.1

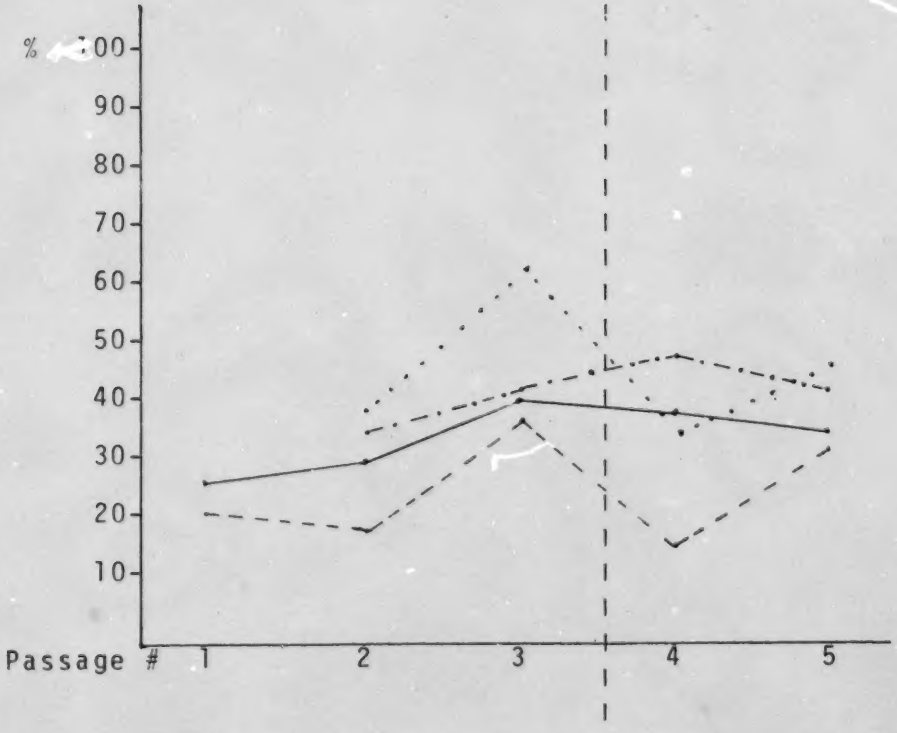

Figure 1.2

——— = minutes of study time
– – – – = % recalled (free)
–·–·– = % of ideas in notes and free recall
. . . . . = % match between ideas in teachers' and students' notes

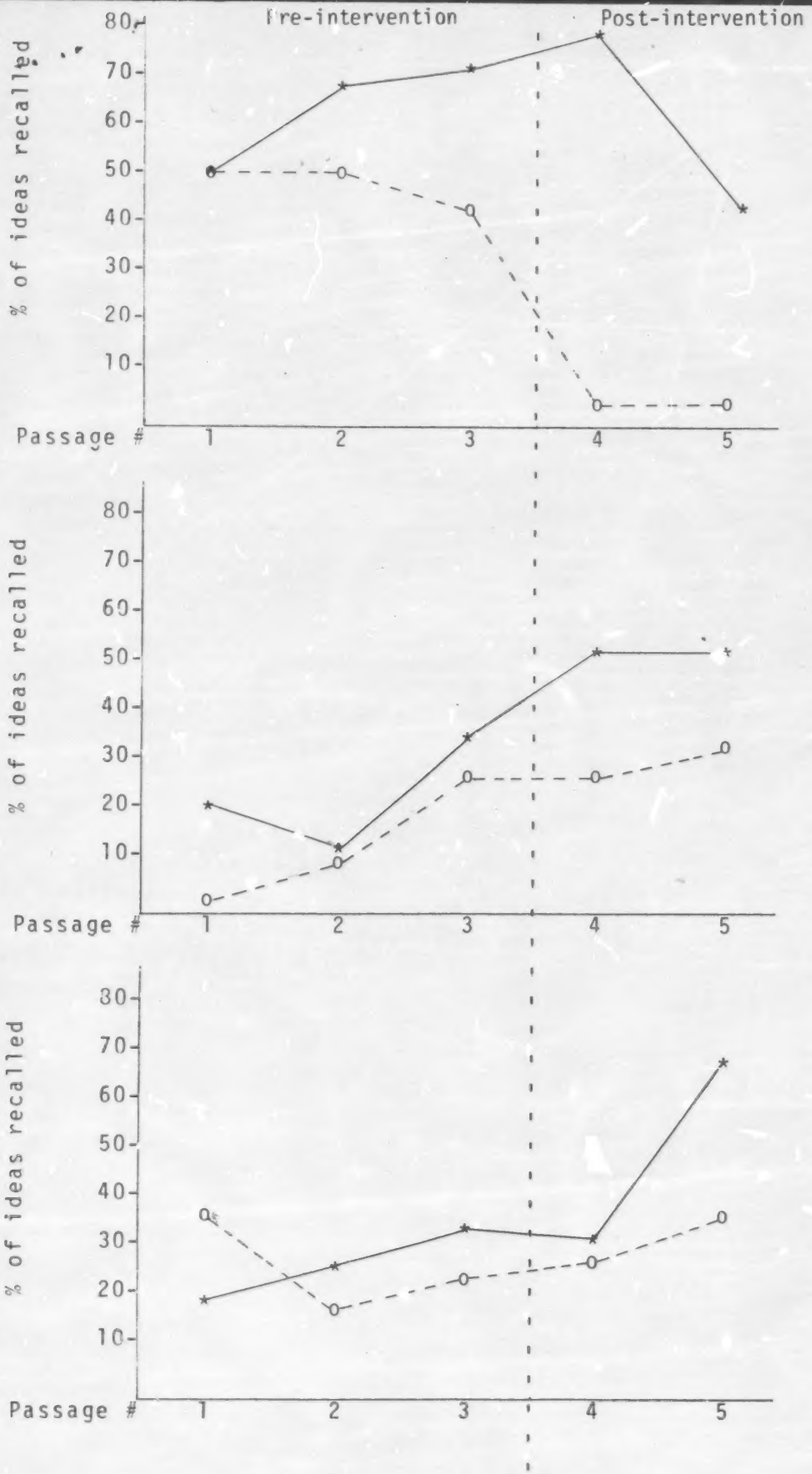
Pre-intervention
Post-intervention
% of ideas recalled
80
70
60
50
40
30
20
10
Passage #
1
2
3
4
5
Level 1
Level 2
Level 3
* = Student X = ———
o = Student Y = - - -

Figure 1.3